AJEMA GLOBAL RESEARCH NETWORK

AMERICAN Journal of Engineering, Mechanics and Architecture
Volume 3, Issue 12, 2025 ISSN (E): 2993-2637

Design and Structure of Functional Textiles for Bed Applications

Khamraeva S. B
Karshi State Technical University

S. Hamrayeva
Associate Professor, Karshi State Technical University

Abstract: The analysis of medical fabrics showed that the assortment continues to develop, and new fabrics with improved consumer properties appear.

Keywords: elastic fabric, stretchable, natural, chemical, artificial fibre, polyurethane thread.

To date, the range of medical fabrics is diverse. The analysis of medical fabrics showed that the assortment continues to develop, and new fabrics with improved consumer properties appear. To improve the range of medical fabrics, it is necessary to conduct a study of consumer preferences. For a long time, cotton fabrics were considered traditional fabrics for the manufacture of medical bedding and clothing; however, a modern alternative to them is blended fabrics. Due to the introduction of chemical fibres into the fabric and the possibility of regulating the different ratios of natural and chemical fibres, it is possible to improve the indicators of mechanical, physical and hygienic properties and create fabrics with specified consumer properties. The need for bed linen and clothing with special functions is associated with changing environmental conditions, human activity or physical condition and becomes essential for sick people who are in the most vulnerable position. The use of bed linen and underwear ideally suited for bedridden patients is an important element of special mattresses and pillows that prevent the formation of bedsores. These are the reasons why the tissues with which the patient is in constant and direct contact play an important role in preventing bedsores. The standard hospital sheets used are coarse, which can lead to ulcers, and sheet fabrics absorb moisture and heat released by the human body, creating an ideal environment for the growth of microorganisms. Additionally, the bed linen is single-layered, which contributes to the rapid sliding of the bed linen from the mattress and the formation of folds, which in turn complicates the care of patients with bedsores and creates inconvenience for them. The range of hospital linen for severely immobile patients is extremely limited, does not meet modern medical requirements, and does not take into account the possibilities of modern technologies, the properties of new materials and their special finishes.

From the above considerations, it can be concluded that textiles used for bed linen and underwear for patients should have a smooth surface and good transfer of moisture and heat from the body of the sick patient.

Bed linen plays an important role in the prevention and treatment of pressure sores. Bedsores are a problem that occurs in bedridden people when small capillaries of the skin are under constant pressure. Constant compression of the capillaries causes the cessation of blood flow. The formed dead cells break through the surface of the skin, forming ulcers - bedsores. There is a clear need for funds to prevent bedsores. The front side of the bed sheet for bedridden patients should have a smooth surface and a greater coefficient of friction in the length of the base and should be much smaller across the weft. The wrong side of the bed linen should have a relief effect, which will ensure stickiness from the surface of the mattress[1].

The standard hospital sheets used are coarse, which can lead to ulcers, and sheet fabrics absorb moisture and heat released by the human body, creating an ideal environment for the growth of microorganisms. The range of hospital linen for severely immobile patients is extremely limited, does not meet modern medical requirements, and does not take into account the possibilities of modern technologies, the properties of new materials and their special finishes[2].

Domestic and foreign research and experience show that the best positive properties of cellulose fibres are manifested in optimal mixtures: 50-67% cellulose fibre and 50-33% cotton. The production of mixed fabrics makes it possible to give bedding products from them sufficient comfort and significantly improve consumer properties in comparison with cotton[3].

For this purpose, samples of experimental fabrics for bed use on SOMET looms were developed at the Department of “Technology of Textile fabrics”. In the production of all fabric samples, 100% cotton yarn with a linear density of 25x2 tex was used as the main thread, and raw materials were used as weft threads, which consisted of a mixture of 50% modal cellulose yarn and 50% cotton yarn with a linear density of 30 tex[4-5].

The I sample was obtained by plain weave with variable layers of fabric 6:1. This ratio of layers forms recesses and bulges on the surface of the fabric, which ensures good air exchange and the transfer of moisture and heat from the patient's body. Figure 1 shows a diagram of a fabric cut with variable layers. The tissue rapport on the weft is equal to R y = 14, and the tissue rapport is Ro = 72. This ratio of layers forms recesses and bulges on the surface of the tissue, which ensures good air exchange and the transfer of moisture and heat from the patient's body. The contact of the patient's body with the air flow causes good blood flow in the capillaries of the skin. This tissue structure provides a massage effect, which improves blood circulation and allows you to eliminate pressure sores on the body

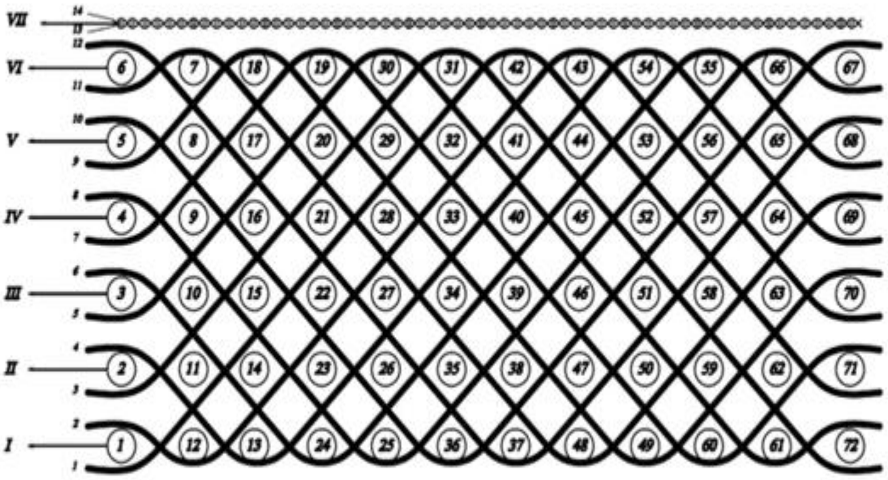

Fig. 1. Diagram of the cut of the fabric with variable layers I- warp threads of the first layer; II- warp threads of the second layer; III- warp threads of the third layer; IY- warp threads of the fourth layer, Y- warp threads of the fifth layer; YI- warp threads of the sixth layer; YII- warp threads of the single-layer part of the fabric; 1,2,3,4,5,6,7,8,9,10,11,12,13,14- laid weft threads of each layer of fabric. Figure 2 shows the structure of the fabric structure

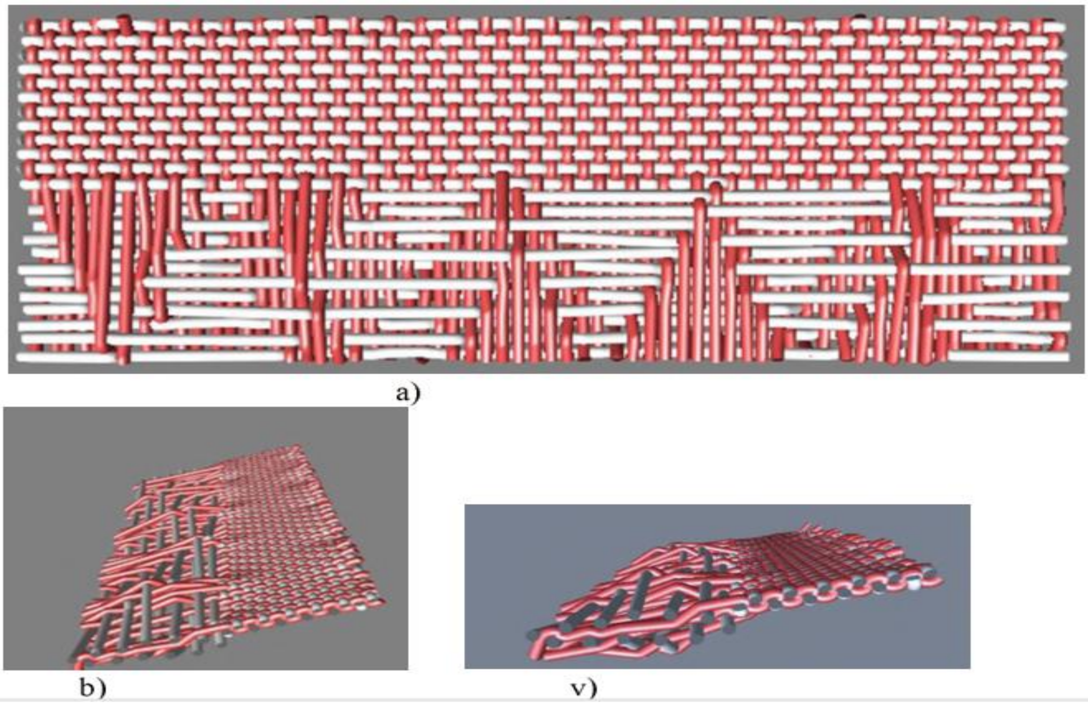

Fig. 2 Structure of threads in fabric

a) Structure of the fabric from the upper side; b) structure of the fabric from the front side; c) structure of the fabric from the cut of the warp threads

II sample was produced by plain weave fig. 3. As shown in Figure 3, the sheet fabric has an interlacing of a continuous series of main and weft overlaps. At the same time, thickened weft threads from cotton yarn 1 with a linear density of T = 800 tex (section on fabric a) alternate with thinned weft thread from cotton yarn 2 with a linear density of T = 20 tex (section on fabric b), intertwining with the main threads of the same number 3, 4. The diameter of the thread is determined by the formula d =0.0395Wt. For yarn 800 tex after calculation, d=0.0395W800=1.1 mm. For yarn 20 tex after calculation, d=0.0395W20=0.2 mm. Consequently, on the fabric, section a has a size equal to 1.1 mm, and on the fabric, section b has a size equal to 0.2 x 3 = 0.6 mm, which creates stripes of grooves and bulges on the surface of the fabric. The fabric is produced by plain weave cotton yarn with a linear density based on T = 20 tex. When laying thickened weft yarn, the thickness of the fabric increases; when laying thinned weft yarn, the thickness of the fabric decreases, so the surface of the fabric has a relief shape in which grooves are formed along which the air flow moves. The contact of the patient's body with the air flow causes good blood flow in the capillaries of the skin. The dimensions of the groove depend on the alternation and thickness of the weft threads. The most rational alternation of the duck is 1:3, i.e., one thick duck and then three thin ducks. An increase in the number of thick threads leads to an increase in the contact of the body area with the tissue; in this place, the air exchange decreases, which leads to bedsores. An increase in the areaof fabric made of thin threads leads to a decrease in the relief effect and contributes to the overlap of the groove due to the sagging of the recumbent body in this area. Therefore, the optimal ratio of threads is 1:3. Each 1:3 alternation allows air to pass through the channel (alternating thick and thin weft threads)

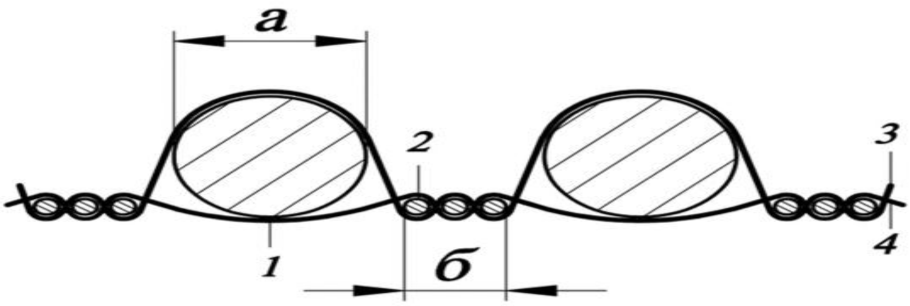

Fig.3. Scheme of the tissue incision

1- Weft thread with high linear density; 2- Weft thread with low linear density; 3,4- warp threads; a) -thickened part of the fabric; b) -thinned part of the fabric The contact of the patient's body with the air flow causes good blood flow in the capillaries of the skin. This tissue structure provides a massage effect, which improves blood circulation and allows you to eliminate pressure sores on the body

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